A Non-Governmental Organization to Manage Utilization of the International Space Station*

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Abstract. Assembly of the International Space Station (ISS) is well underway with payload operations in the United States Laboratory *"Destiny"* successfully initiated earlier this year. This milestone represents a turning point in the progress of low-Earth orbit research and development, and holds open the promise that one day a new economy, brought about through routine operations in the microgravity and ultravacuum environments of space, may emerge. The U.S. government role in enabling the deployment of orbital laboratories, observatories and test beds is consistent with longstanding national policy to allocate public funds to high cost, long-term science & technology investments which do not bear the rapid financial return necessary for private capitalization. The corresponding role of the National Aeronautics and Space Administration (NASA), in this case, is to ensure that the most cost effective and productive approach is employed to manage use of this valuable national asset. To this end, NASA has been carefully and deliberately, over a period of years, advancing the prospect of a non-governmental organization (NGO) to manage ISS utilization. This paper reports on the history of NGO concept development, the current status of Agency plans, and potential outcomes for the ISS in the 21ST century.

Introduction

The ISS is an extraordinarily complex host spacecraft with the capability to accommodate a broad range of scientific, technological and commercial projects through multipurpose laboratories, observatories and test beds. Due to physical and fiscal constraints, planning for utilization of these diverse features is a challenging task requiring unique expertise and proficiency. Fundamental to the challenge is the recognition that research and development (R&D) is, by nature, a relatively unpredictable and uncertain enterprise which demands flexibility, responsiveness, and continuity if it is to be productive. The environment of government agencies limits these characteristics. The inertia of past practices constrains flexibility; institutional procedure and protocol slow responsiveness, and; changing leadership structures affect continuity.

In an effort to relieve these limits, we began considering the prospect for a NGO to manage the U.S. share of ISS utilization during the mid 1990's. Exploratory discussions were held with administration executives, legislators, advisory committees, and international partners. Early concept models were developed and external studies were undertaken to obtain objective opinions and recommendations. Gradually, a consensus formed -- the NGO option warranted close examination. Guidance was received from both the White House and the U.S. Congress, while NASA pursued an internal study to understand the

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comprehensive scope of station utilization management. Finally, an implementation plan has been developed which provides the general framework for a time-phased approach to acquire, qualify and complete the transition to NGO operations for selected utilization functions.

At this stage in the station assembly phase, the challenge to complete construction and achieve the full scope of spacecraft operations as originally conceived remains paramount. This will be overcome in time due to the perseverance and ingenuity of dedicated individuals around the globe who share in the vision for human exploration and development of space. Pursuant to this achievement, the opportunity for nearly continuous operating laboratories will emerge and the mission of the ISS will be realized.

At the close of the 19TH century, scientists and engineers were only beginning to understand the characteristics and significance of vacuum environments and the use of these environments as tools for technological advance. By the end of the 20TH century this new knowledge had fueled nothing less than a sweeping industrial revolution in the field of microelectronics. Now, we stand with the 20TH century recently closed behind us and find that we are just beginning to understand the microgravity environment. As a 21ST century tool, microgravity holds an analogous potential to enable dramatic technological growth -- perhaps this time in microbiological applications.

NGOs have an important role to play in the rate of scientific advance and in ensuring useful applications. While the strategy for allocating public funds to R&D remains an inherently governmental function, managing the R&D operations on a day-to-day basis may be best left to a flexible, responsive and stable NGO of the highest caliber.

Early Concept Development

Following the ISS program Critical Design Review and parallel 1993 restructuring, the NASA Associate Administrator for Life and Microgravity Sciences and Applications directed a study be performed regarding the potential for creating an institute to manage station utilization. By early 1995, the concept of an "Orbital Research Institute for Science and Technology" had taken shape and was introduced to the international partners.[1] Preliminary discussions were held with NASA advisory bodies during the same timeframe with mixed reviews. Most agreed the prospect held promise; but, they were also pessimistic with a view that final implementation could fall significantly short of the idealistic objectives and, ultimately, lead to further complication of the already long and convoluted processes associated with deploying R&D experiments in space. Further studies were called for to define the details of task responsibility.

At the time, further work was suspended in favor of pursuing a series of discipline-specific institutes as recommended under the NASA zero base budget review which had just been completed. Over the next several years, four of these disciplinary institutes were eventually created: (1) National Space Biomedical Research Institute in Texas; (2) National Center for Microgravity Research in Combustion and Fluids in Ohio; (3) Astrobiology Institute in California, and; (4) National Space Science and Technology Center in Alabama. One could speculate that a vision at that stage was to create a body of distributed, discipline-specific institutes that could later be united through a central hub as a research system in the form of a quasi-governmental National Institutes of Space. Had such a strategy existed, it was destined to never reach the implementation phase due to a change in the responsible NASA Associate Adminstrator.

The NGO concept re-emerged again in 1998 following restructuring of NASA programs into a series of "enterprises". The Associate Administrators for the Human Exploration and Development of Space enterprise called for renewed efforts to define a NGO for privatization of station utilization management. The "reference model" was updated and included as a key initiative in response to the Commercial Space

[1] Uhran, M., *Orbital Research Institute Concept for the International Space Station*, International Forum on Scientific Uses of the Space Station, Noordwijk, The Netherlands, 17 May 1995.

Act of 1998.[2] This model attempted to expand the original concept by including all three missions of the space station: (a) scientific research; (b) technological advance; and (c) economic development. Figures 1 and 2 summarize the basic operating model with an accompanying transaction diagram.

We quickly recognized the great challenges associated with integrating the competing missions, while also ensuring upward compatibility to a global scale of user operations. The NASA institutions were also reticent to support any change to the existing approaches and organizations. As a result, an external study phase was initiated in order to obtain objective perspectives and gather recommendations from independent sources.

External Study Phase

During 1999 and 2000, three external studies were performed. An independent assessment was necessary, so we enlisted the National Research Council. An objective trade study was needed to understand the range of structural options and precedents from a legal and statutory perspective. Finally, the interface to the overall station operations architecture needed to be explored. The results of each of these studies are summarized below with full copies of the final reports available through the internet.[3]

National Research Council Task Group Report

In January 1999, the National Research Council, under the auspices of the Space Studies Board and the Aeronautics and Space Engineering Board, took steps to establish a task group to review alternative Institutional Arrangements for Space Station Research. The group consisted of fourteen individuals with wide-ranging expertise in the operation of academic, industrial and federal laboratories, as well as sound experience in formulating science and technology policy. They conducted an eight month study to assess the feasibility of employing a NGO approach to manage space station utilization and completed their report in December 1999.[4]

The report recommends that NASA "should plan on establishing a NGO in three phases" representing the near term, a transition phase and a long term phase.[5] The report also provides conclusions and recommendations on guiding principles related to the mission of the organization, structure and governance, location and staffing, relations with commercial users, budget authority, and specific roles and responsibilities. These findings represented an important step in the process of further defining and implementing a NGO as part of the overall architecture for station utilization, operations and maintenance.

Trade Study on Options and Precedents

In June 1999, NASA initiated a trade study on the statutory and regulatory constraints associated with various forms of NGOs, as well as the advantages and disadvantages of each. For every option, NGO precedents were identified and unique attributes evaluated. A series of evaluative factors were developed to assist in measuring the relative effectiveness of each option in meeting objectives. This study was completed in November 1999.[6]

No conclusions were drawn by the authors of the trade study. Their objective was intentionally limited to thoroughly describing the options and the enabling steps in each case. Our intent was to gather objective

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[2] Uhran, M., *Reference Model: A Non-Government Organization for Space Station Utilization Management*, Commercial Development Plan for the International Space Station, Attachment 3, 16 November, 1998.
[3] All reports are available at: http://commercial.hq.nasa.gov/rnp.html.
[4] National Research Council, *Report of the Task Group on Institutional Arrangements for Space Station Research,* December, 1999.
[5] Ibid. (4), Recommendation 12, pp. 46-47.
[6] Sobieski, S. and Simon, M., *Options for Managing Space Station Utilization*, Swales Aerospace, Inc., Contract NAS5-32650, Task #649, November, 1999.

and accurate information from which to support an informed decision in close cooperation with the White House and Congress. This information represented a second valuable step on the path toward implementation. From this study, and prior NASA experience with NGOs responsible for various aspects of spacecraft operation, we concluded that a competitively procured direct contract represented the greatest potential for success.

Operations Architecture Study

In January 2000, the NASA Office of Space Flight commissioned an independent *ISS Operations Architecture Study*. Over the next five years all major operations and development contracts involving human space flight would either terminate or come up for renewal via contract options. The objective of the study was to provide an independent recommendation for a space station operations architecture that included a justification and cost benefit analysis. The study also provided a strategy that detailed impacts to current government organizations and existing operations contracts. The study was completed in August 2000 and recommended formation of a Space Station Utilization and Research Institute which would interface directly with the station operator.[7]

Actions from the United States Congress

In Fall of 2000, both the Authorization and Appropriations Committees of the U.S. Congress, in light of the three external studies completed by NASA, also took up the debate as to whether a NGO to manage station utilization was needed. Specific direction was provided in both Acts of Congress, as well as in the companion Conference Reports.[8]

Authorization Act and Conference Report

The Authorization Act required NASA to enter into an agreement with a NGO and to deliver an implementation plan the following year, with specific directions for what the plan was to include:

> "Sec. 205. Space Station Research Utilization and Commercialization Management
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> - Research Utilization and Commercialization Management Activities. – The Administrator of NASA shall enter into an agreement with a non-government organization to conduct research utilization and commercialization management activities of the ISS subsequent to substantial completion as defined in section 202(b) (3). The agreement may not take effect less than 120 days after the implementation plan for the agreement is submitted to the Congress under subsection (b).
> - Implementation Plan. – Not later than September 30, 2001, the Administrator shall submit to the Committee on Commerce, Science and Transportation of the Senate and the Committee on Science of the House of Representatives an implementation plan to incorporate the use of a non-government organization for the ISS. The implementation plan shall include –
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> (1) a description of the respective roles and responsibilities of the Administration and the non-government organization;
> (2) a proposed structure for the non-government organization;
> (3) a statement of the resources required;
> (4) a schedule for the transition of responsibilities; and
> (5) a statement of the duration of the agreement."

[7] Cox, J., (ed), *ISS Operations Architecture Study*, Computer Sciences Corporation, Contract No. GS-23F-8029H, August, 2000.
[8] U.S. Congress, H.R. 1654 *Authorization Act for NASA*, Section 205, p. 1654 with *Conference Report* 106-843, p.34 and H.R. 4635 *Appropriations Act for NASA* (incorporating H.R. 5482 House Bill, p. 111), with *Conference Report* pp. 153-154, 18 October 2000

The accompanying Conference Report elaborated on this direction at length:

> "Section 205. Space station research utilization and commercialization management.
> The conferees further note that as the ISS approaches full assembly, NASA must begin to focus on establishing an organizational infrastructure capable of ensuring that the ISS is fully and effectively utilized for scientific and engineering research. The conferees commend NASA for initiating a review of management structures by the National Research Council's Space Studies Board and Aeronautics and Space Engineering Board. The national Research Council recommended that a "consortium led by a research institution or group of institutions, governed by an independent board of directors, managed by a strong scientific director, and guided by an advisory process that is broadly representative of the research community" be charged with managing scientific activities aboard ISS. The conferees further note that NASA has had success with utilizing non-government organizations for the operation of major scientific research programs, such as the Hubble Space Telescope. Conferees are also concerned about commercialization opportunities aboard the Space Station. The non-government organization should ensure that equitable opportunities exist for industry to participate in activities. NASA should work with the Department of Commerce's Office of Space Commercialization to ensure that the selected non-government organization has adequate expertise in this area. The conferees therefore direct NASA to enter into an agreement with a non-government organization that will manage the research utilization and commercialization aspects of the ISS. The non-government organization should be selected competitively."

Appropriations Act and Conference Report

The Appropriations Act placed limits on NASA expenditure of funds related to finalizing a NGO:

> "No funds in this or any other Appropriations Act may be used to finalize an agreement prior to December 1, 2001 between NASA and a non-government organization to conduct research utilization and commercialization activities of the International Space Station.";

while the Conference Report directed a plan be prepared for various management options:

> "The conferees do not agree with the Senate requirement for a blueprint plan that identifies lead and complimentary [sic] universities that will coordinate with NASA for science disciplines that will be the focus of research after assembly of the ISS is complete. The conferees direct NASA to submit a plan to the committees on Appropriations of the House and the Senate which includes various ISS management options. The conferees agree that such a plan will give the Congress the information it needs in order to determine what management structure is best and most able to deliver the benefits of the ISS. The Committee on Appropriations will require this information prior to approving funding for any final agreement. Therefore, the conferees have included an administrative provision which prohibits the expenditure of funds prior to December 1, 2001 for finalizing an agreement between NASA and a non-government organization to conduct research utilization and commercialization management activities of the ISS."

In any case, there were no NASA requirements for expenditure of funds on a station NGO prior to December 2001. Instead, the net effect of the legislation was to require NASA to submit two separate plans: (1) an "implementation plan" for a NGO to the authorizers, and: (2) a "plan… which includes various management options" to the appropriators.

NASA Internal Study Team

In the Spring prior to the October 2000 legislation, a NASA internal study team had been formed to define in detail the full scope of functionality associated with ISS utilization management. Its members included representatives from the nine affected organizations; each of which held responsibility for various aspects of ISS utilization program management. At the onset, the team was provided three primary objectives for a prospective NGO:

- to facilitate the pursuit of flight research and make the complex operating environment associated with the ISS transparent to the end user;
- to reduce the end-to-end cycle time associated with the announcement, selection, development, flight, and achievement of results for ISS research and development; and
- to increase the long-range productivity of research and development by most effectively integrating and advocating academic, government and industry utilization of the ISS.

Team activities accelerated in response to the new legislation and a final study report was delivered to NASA senior management in June 2001.[9] The report was exhaustive in its audit of functions related to station utilization management. Organized according to twenty top level "tier one" functions, the volume traced to the lowest level of detail: individual statement-of-work elements and work breakdown structures. Civil service labor, with cost conversions, was determined and the value of all contracted efforts was projected over a five-year period. The final report provided a well-organized and comprehensive definition of the scope of work associated with ISS utilization management.

The study team, however, was not a strong advocate for the NGO option and recommended further systems engineering studies before proceeding to a final decision. Although the team had been successful in producing conservative and aggressive models for NGO v. NASA roles, these models only bracketed the solution set and did not represent a final framework for responsibilities.

Action from the White House

In March, 2001, as the internal study team was finalizing its report, the White House released its "Blueprint for a New Beginning" which represented the President's vision for change across the Administration as embodied in a ten-year budget plan. Included among the guidance to NASA was specific direction which resolved the NGO question:

> "open future Station hardware and service procurements to innovation and cost-saving ideas through competition… including a NGO for Space Station research".[10]

The outcome was becoming clear – with three external reports and one internal report completed, and with executive and legislative branch direction to implement a NGO, the time for further studies was drawing to a close.

Resolution and Implementation Planning

In September 2001, Agency senior executives undertook a series of reviews and the option for a NGO to manage station utilization was cleared for implementation on an accelerated basis. Under leadership of the NASA Chief Scientist and acting Associate Administrator for Biological and Physical Research, the top level functions identified by the internal study team were allocated into three categories:

- functions to be retained by NASA, and Principal Investigators;

[9] NASA Internal Study Team, Final Report on NGO Concept Development for Management of ISS Utilization, June 2001.
[10] White House, Office of Management and Budget, A Blueprint for New Beginnings: Overview of the President's Ten Year Budget Plan, Section 33, p. 155, March 2001.

- functions to be considered for a NGO support role; and
- functions to be considered for a NGO leadership role.

This action represented the final gate necessary for preparation of an implementation plan in response to the prior year legislation. The plan has since been completed in draft form and submitted to NASA senior management for review and approval. It will become a public document upon release to the Congress in the next several weeks.

Conclusion

With these steps behind us, we plan to conduct a competitive procurement in FY 2002 leading to a direct contract for ISS utilization management services. We will be coordinating with the White House and the Congress before proceeding. Further statements will be issued through the standard procurement process and in strict accordance with applicable provisions of the Federal Acquisition Regulations. We intend to proceed, once again, carefully and deliberately in a manner that ensures all perspectives are brought to bear on this mission critical endeavor.

Acknowledgements

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Figure 1: Basic Model

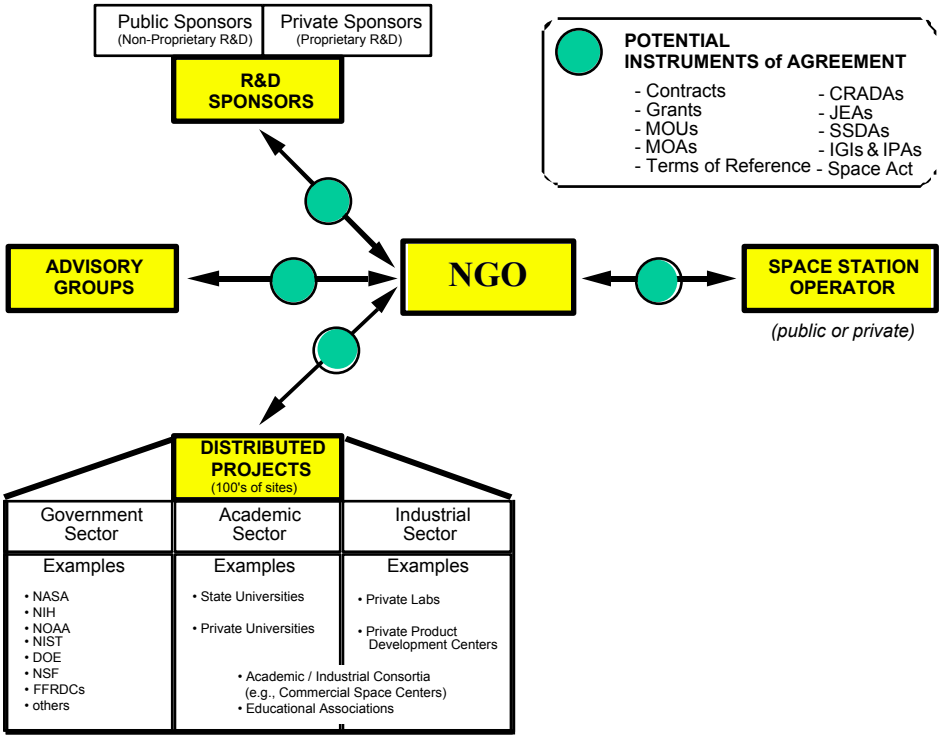

Figure 2: Transaction Diagram